MWMF Letter

Mixed Waste Management Facility
Lawrence Livermore National Laboratory

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Panel opens dialogue on mixed waste facility

Proposed Lab facility would allow treatments to be tested, evaluated

(Extracted from an article by Don Johnston in the June 23 issue of Newsline, the LLNL newspaper)

The Mixed Waste Management Facility (MWMF) National Review Panel met for the first time Tuesday, June 20, at Lawrence Livermore National Laboratory (LLNL) to initiate a public dialogue on the demonstration of mixed waste treatment technologies.

Representatives from the Lab project, the Department of Energy, the state of California, Alameda County, the city of Livermore, and Tri-Valley CAREs were welcomed by Jay Davis, acting associate director for Environmental Programs. Discussions focused on the project's purpose, scope and regulatory requirements.

The project would serve as a "national testbed" to demonstrate safe, effective, and environmentally acceptable technologies for treating the growing inventory of low-level organic mixed waste generated by Department of Energy facilities. Mixed waste contains both hazardous and low-level radioactive components.

These new technologies would offer alternatives to the use of incineration. Currently in the design phase, the facility is scheduled to begin operation in 1998.

"We're developing a facility that will be used into the next century to evaluate new technology," MWMF Project Manager Ron Streit told panelists in his overview. The project is to demonstrate technology, not to do treatment.

"lt is unique in that it will be the only fully integrated pilot-scale demonstration facility for mixed waste in the country," he said. "The facility will address all aspects from preparation of waste for treatment to preparation of final waste forms after treatment."

The Lab is working closely with private industry in developing the technology with a view to eventually transferring the technology for commercial use. "A key goal of the project is to involve industrial partners in all phases of the project, and if the technologies are successful, we'd like to use them at LLNL," said Martyn Adamson, leader of waste treatment technologies development at LLNL.

Another issue sparked during the discussion was over the choice of molten salt oxidation (MSO) as the first technology to be demonstrated in the MWMF. MSO uses a flameless reaction to oxidize—destroy—the organic constituents of mixed and hazardous waste. In the process, the salt bath virtually eliminates toxic by-products, like dioxins, which may be found in incineration exhaust.

Welcome to the first issue of the MWMF Newsletter. If you have any questions or want to get on our mailing list, please call Bert Heffner at (510) 424-4026, or write him at UC/LLNL, L-404, Livermore, CA 94550

Adamson stressed that the intent of the project is to be able to do comparative testing of alternative technologies. "We don't believe any one technology can treat all wastes," he said. "We're developing a suite of technologies."

MSO was chosen over non-thermal technologies because it can be used to treat a wide variety of waste streams, according to Adamson, who added that a white paper was prepared for the Environmental Protection Agency (EPA) explaining why MSO is not incineration.

State of California permit requirements put the project in a "catch-22" dilemma, Streit said. Because the technology is still in its infancy, the data needed to obtain even a Research Development and Demonstration (RD&D) permit cannot be obtained without testing.

Project leaders and state regulators as well as most members of the panel agree that the facility should be built and tested using surrogate waste. The data will then be used to apply for the appropriate permit from the Department of Toxic Substance Control.

DOE and state panelists said that evaluating the project's economic viability is a part of the planning and design process. The economics of the MWMF is a condition of obtaining an RD&D permit, said Terry Escarda of the California Department of Toxic Substance Control. "That's something we're taking a keen interest in."

Cathy Owens, a member of DOE's mixed waste Focus Area Implementation Team, said "every technology we demonstrate has to show a market."

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She said the project is striving to adhere to a strict DOE timetable while absorbing budget cuts and addressing public concerns about environmental risks. DOE wants demonstration technologies in place by the end of 1997.

The next meeting of the MWMF National Review Panel is expected to take place later this summer when the project's Environmental Assessment will be available for their review.

Streit noted that the meeting allowed many of the major stakeholders to raise and discuss their concerns about the testing of new mixed waste treatment technologies. "We got a lot on the table that will help this project move forward," he said. "This input is vital to deploying acceptable waste treatment systems for our nation's mixed waste problem."

Molten Salt Oxidation Technical Profile

Molten Salt Oxidation (MSO) is a technology useful in the disposal of hazardous and low-level mixed wastes (LLMW) that have primarily organic liquids or sludges. This technology is also expected to work well on organic solids with a maximum dimension of about 6 mm (for injection purposes). Candidate DOE mixed waste streams for molten salt oxidation treatment include: spent solvents, oils, and other organic liquids; crucible graphite; plutonium-contaminated leaded gloves; and ion-exchange resins. This technology will also interest those responsible for the disposal of energetic materials (explosives, propellants, and pyrotechnics), chemical warfare agents, and medical wastes. Although easily scalable to larger throughputs, we're designing the MWMF MSO system for no more than 20 kg/hr.

What Is Molten Salt Oxidation?

MSO is a catalytic thermal process to completely oxidize (destroy) the organic constituents of mixed and hazardous waste. The flameless reaction takes place at 700 to 950°C in a pool of benign salts, usually sodium carbonate (soda ash) or mixtures of other similar salts. Oxidant air and the waste stream are added together into the salt bath. Because the reaction takes place within the salt bath, the fugitive inventories found in incineration are virtually eliminated. The organic components of the waste react with oxygen to produce carbon dioxide, nitrogen, and water. Halogens and heteroatoms such as sulfur are converted to acid gases, which are then "scrubbed" and trapped in the salt in forms such as sodium chloride and sodium sulfate. Other incombustible inorganic constituents, heavy metals, and radionuclides are held captive in the salt, either as metals or oxides, and are easily separated for disposal.

How Mature Is this Technology?

Molten salt technology is not new. Rockwell International used the process approximately 20 years ago for coal gasification. During that period, they also demonstrated the effectiveness of molten salt for destroying hazardous organics such as PCBs and chlorinated solvents. Recently, molten salt has been demonstrated as an effective method for the destruction of mixed waste oils and energetic materials. The technology is mature enough to be put into a pilot-scale unit in the next few years.

Does MSO Have Advantages over Incineration?

MSO has many advantages over incineration:

- In an incinerator, hot spots and feed inhomogeneities limit the process controllability. In MSO, however, the large thermal mass of the molten salt provides a stable heat-transfer medium that resists thermal surges and ensures a uniform temperature, so MSO can tolerate rapid process fluctuations.
- MSO eliminates the generation of acid gas because the acid gases (such as hydrogen chloride and SOx) are "scrubbed" by the alkaline carbonates, producing only water (steam) and the corresponding salt.
- The formation of secondary toxins (dioxins, furans, and other products of incomplete combustion) is much less likely with MSO because chlorine is removed before the gas leaves the molten salt bath.
- MSO generates less off-gas because there is no fuel required to sustain or initiate a flame.
- MSO completely avoids flame-outs because it is a non-flame process that works by catalytic liquid-phase oxidation reactions.
- The MSO system operating temperatures, hundreds of degrees lower than flame combustion temperatures, minimize emissions of the radioactive materials from mixed wastes.
- Since it is not an incinerator, permitting the MSO process should be easier than permitting an incinerator would be.

Can MSO Be Integrated into a Complete Waste Processing System?

The MSO process is compatible with extensive use of standard industrial equipment, although the reactor vessel and feed injection system are uniquely designed and not off-the-shelf items.

Has MSO Been Critiqued by Anyone?

Two independent reviews of MSO have been conducted. In November 1991, the DOE Grand Junction Projects Office conducted and facilitated a peer review process through its prime contractor, Chem-Nuclear Geotech, Inc. This provided a baseline evaluation of the MSO technology and established its present and potential readiness to treat DOE wastes. The second review was held in December 1993 by a panel of eight independent technical and program management experts. They conducted a technical review of MSO's attributes and determined that the technology was sufficiently promising as an alternative to incineration to be advanced to a pilot-plant stage.

MWMF Sets Its Strategy

A project as big as the MWMF cannot afford to charge into battle without a strategy. According to the Interim Mixed Waste Inventory Report, April 1993, DOE's current inventory of low-level mixed-waste is 247,000 cubic meters. It is estimated that about 88% of that contains some hazardous organic contaminants. Medicine, research, and industry face the same problem. Given the challenge of demonstrating alternatives to incineration for treating this waste, DOE and MWMF project manager Ron Streit and his staff have some important decisions ahead of them. Fortunately, two crucial decisions are behind them: what to treat and how to treat it.

Picking the target

According to Streit, organics comprise about 30,000 cubic meters, or 12%, of the total volume of waste. "Because the inorganic component of many DOE waste streams can be separated and stabilized," says Streit, "it is the organic components—organic liquids, organic solids, and condensed liquids and gases after thermal desorption—as well as the aqueous liquid streams that are of interest for treatment in the MWMF."

The MWMF team has chosen to treat waste streams that represent DOE's low-level mixed incinerable and aqueous/liquid waste streams. (The waste categories and inventory amounts are summarized in the pie charts below.) "For all of these waste streams," points out Streit, "incineration is currently listed as the best demonstrated available technology. We're hoping to demonstrate an alternative to incineration."

The streams selected for treatment in the MWMF include aqueous liquids, organic liquids, combustible solids, and scintillation cocktails. Says Streit, "the organic liquids to be treated include halogenated and nonhalogenated solvents, oils, etc. The combustible solids include paper, cloth, plastics, and heterogeneous wastes contaminated with hazardous liquids and/or metals."

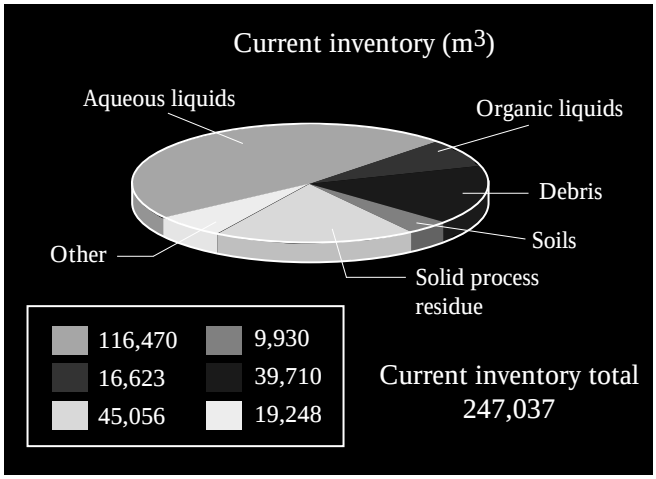
The MWMF demonstration will also include the treatment of aqueous waste streams that are not incinerable but are a component of the DOE inventory. These aqueous streams include both halogenated and nonhalogenated organics in water. The actual aqueous streams selected for treatment in the MWMF contain the following organic contaminants: Trimsol (a cutting oil), vacuum pump oils, waste oils, benzene, toluene, and other nonhalogenated solvents.

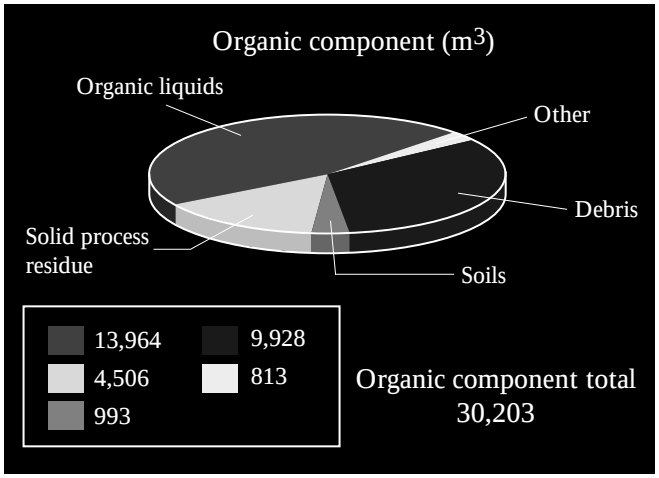
Choosing the tools

Streit and the MWMF team must carefully choose not just what to treat for demonstration, but also how to treat it. "We looked at over 20 technologies for potential demonstration in the MWMF," he explains. "We categorized the technologies into one of three groups: selected for demonstration, selected for potential future demonstration, or rejected as a viable process for demonstration within the MWMF."

For the initial operations, the MWMF has selected Molten Salt Oxidation (MSO), Mediated Electrochemical Oxidation (MEO), and Wet Oxidation (WOX). However, due to budget constraints, MSO will be the first primary process brought on-line. Steam Reforming/Gasification is the backup technology for the waste stream that MSO is designed to treat. (The selection criteria used are shown on page four.)

Additional treatment technologies will be integrated into the MWMF once they are successful at bench scale and have been selected as appropriate for demonstration in this facility. According to Streit, "the principal reasons for rejection of other robust, potentially broad-spectrum treatment technologies were high-temperature incineration-like qualities, unproven aspects of process, slowness, very waste-stream specific or limited waste stream applicability, or the fact that demonstrations are underway at other sites. And others were just potentially very costly."





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Selection criteria for primary treatment systems

The primary treatment systems must:

1. Be an alternative to incineration.
2. Effectively treat a range of waste streams.
3. Be successful in lab- and bench-scale tests.
4. Be equivalent to BDAT when BDAT is incineration.
5. Have no environmental, technical, or safety barriers.
6. Interest DOE, EPA, or industry.
7. Meet other considerations (provide a range of technical options, treat waste streams not appropriate to incineration, etc.).

Business Booms

It seems some businesses think developing alternatives to incineration for mixed waste could make dollars and sense. Over 65 potential suppliers, partners, and team members have responded to publicity and advertising in industry and business publications or through outreach at trade shows. At least one Cooperative Research and Development Agreement is in the works, and other forms of working together with many firms are being explored.

We are looking at over a dozen vendors, from Oakland to Burbank, Massachusetts to Colorado, as possible suppliers to the MSO salt recycle system.

Other vendors from throughout California, mostly the Bay Area, and even from Connecticut and New York have already supplied needed hardware, supplies, and services to the Facility. And the brand names are top drawer. Control system suppliers, for example, include Allen-Bradley, Dell Electronics, Oracle, and QNX.

A small, woman-owned business in Michigan will be helping us improve a unique hand controller for a telerobotic waste handling system.

We also signed a contract with Schilling Development, Inc., which is headquartered and does all its manufacturing in Davis, California, for a robotic manipulator arm.

Of course, we are working with other national laboratories, like Oak Ridge and Sandia, in various aspects of telerobotics. This joint work promises to advance the state of the art and to provide innovations that industry can use and improve.

Read all about it…

We invite you to read the recently completed *Environmental Assessment* (EA) of the Mixed Waste Management Facility. The EA has been reviewed and accepted by the Department of Energy and is now available for public review and comment through September 5 in the Livermore and Tracy city libraries and the LLNL Visitors Center reading room. The EA was prepared under the National Environmental Policy Act.

For more information, contact Bert Heffner, MWMF Public Participation,
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